IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Umang Anand, Joseph Katz	§	Notice of Allowance Date:
	§	Group Art Unit: 3723
Assignee: The Johns Hopkins University	§	Examiner: Dung V. Nguyen
Application No.: 10/010,663	§	Class-Subclass:
Filed: December 6, 2001	§	Atty. Dkt. No.: JHUKA1
For: Porous, Lubricated Mixing Tube For Abrasive, Fluid Jet	§	

APPEAL BRIEF

COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

SIR:

This Appeal Brief is appealing the rejections of claims 1-52 contained in the Final Office Action mailed on June 25, 2003. A Notice of Appeal was timely filed on November 25, 2003.

(1) Real Party In Interest:

The real parties in interest in this appeal are the inventors, Prof. Joseph Katz and his student Umang Anand, Ph.D., and their employer, The Johns Hopkins University, to whom the inventors have assigned this invention.

(2) Related Appeals and Interferences:

Appellants and appellants' legal representative are aware of no appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(3) Status of Claims:

On November 25, 2003, appellants appealed from the June 25, 2003 dated, final rejection of claims 1-52. The claims at that time were exactly as filed, except for claims 13, 26, 39 and 52 which wee amended on April 30, 2003. A copy of claims 1-12, 14-25, 27-38, 40-51 and amended claims 13, 26, 39 and 52 is attached in the Appendix to this brief.

On October 27, 2003, the appellants' in an informal, facsimile communication to the Examiner asked to cancel the rejected, amended Claims 13, 26, 39 and 52. For the purpose of this appeal, it was subsequently decided that this cancellation request should not be considered as part of the entered record for this matter.

(4) Status of Amendments:

An amendment was filed on April 30, 2003 to amend the original application's Claims 12, 26, 39 and 52. This amendment were implicitly accepted into the record on June 25, 2003 when the Examiner expressly rejected under 35 USC § 112 the amended form of these claims.

An amendment that could be considered to have originated from October 27, 2003 communication with the Examiner is not a subject of this Appeal.

(5) Summary of Invention:

FIG. 4 of the present application provides a perspective view of the present invention, an improved abrasive water jet or entrainment cutting jet. Its major elements are an entrainment chamber **10**, a mixing or focusing tube **20** and a lubrication fluid reservoir **28**.

It is instructive to contrast the appellants' invention, as shown in FIG. 4, to that of the design for a typical abrasive water jet as shown in the application's FIG. 2. Major differences which are readily apparent include:

(1) the focusing or mixing tube of the typical abrasive water jet is quite different than that of the present invention (i.e., a solid metal tube versus a uniquely crafted porous tube, for which the knowledge required to make such a tube was only acquired after many hours of experimental research) and

(2) the typical abrasive water jet has no lubrication reservoir through which a suitably chosen lubricant (i.e., preferred lubricants disclosed in the application were identified only after many hours of experimentation) can flow to lubricate the tube's inner surface so as to reduce its high rate of erosion, which is the most commonly identified problem in the use of typical abrasive water jet systems.

It is also instructive to contrast the appellants' invention to that of the design for Prof. Katz's earlier improvements to an "premixed slurry cutting jet" as shown in FIG. 1A of USPN 5,921,846, the disclosure of which the Examiner maintains anticipates most of the present application's claims. Major differences include:

(1) Prof. Katz's USPN 5,921,846 does reveal a type of mixing tube (7 in FIG. 1A) and lubrication reservoir (6 in FIG. 1A). However, these are not the same as those used in the present invention since Prof.'s Katz earlier work was with what is referred to in the cutting jet industry as

a "premixed slurry cutting jet," which is quite different from this industry's other type of jet – the "entrainment cutting jet," which is utilized in the present invention.

(2) Some of the key structural differences between these jets are found in the equipment that lies immediately in front of each jet's mixing tube. The present invention has an "entrainment chamber" **10** which has an inlet **12** for receiving a pressurized water jet, a port **14** through which dry abrasive particles are entrained into a water jet, and an exit **16** through which the water jet and entrained abrasives exit the entrainment chamber **10**.

(3) Meanwhile, FIG. 1A of USPN 5,921,846 has in front of its mixing tube a "slurry mixing chamber" (2 in FIG. 1A) which has only an inlet, through which a slurry of water and abrasives enters and is further mixed as it passes through the chamber, and an exit. It doesn't have or need a "port **14** for receiving a flow of dry abrasive particles" since it takes in a slurry containing wet abrasive particles.

(4) The flow conditions in an "entrainment chamber **10**" and a "slurry mixing chamber" are quite different (e.g., much higher pressures in the "entrainment chamber"); thus, the flow conditions at the entrance of their downstream mixing tubes are very different. It is these significant differences at a mixing tube's entrance that make it a nonobvious matter of how to modify the mixing tube and lubrication reservoir of Prof. Katz's earlier USPN 5,921,846 so that it can operate effectively downstream of the "entrainment chamber" **10** of the present invention.

(6) Issues

The first issue as to this appeal is whether or not the subject matter of Claims 1-4, 6-12, 14-17, 19-25. 27-30, 32-38, 40-43, and 45-51 are 35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

The second issue as to this appeal is whether or not the subject matter of Claims 5,18,31 and 44 would have been 35 USC § 103(a) obvious to one of ordinary skill in the art over Katz and since "discovering the optimum or workable ranges involves only routine skill in the art (*In re Aller*, 105 USPQ 233)."

The third issue as to this appeal is whether or not the subject matter of Claims 13, 26, 39 and 52 would have been 35 USC § 103(a) obvious to one of ordinary skill in the art over Katz in view of Massa et al.'s USPN 6,425,805.

The fourth issue as to this appeal is whether or not the subject matter of Claims 13, 26, 39 and 52 are 35 USC § 112 indefinite.

(7) Grouping of Claims

Appellant presents the following six (6) groups of claims that will each stand or fall together as a group based upon the separate arguments presented for these respective groups below.

A - Independent Claim 1 and Dependent Claims 2-4 and 6-12 which pertain to the combination of a mixing tube **20**, a lubrication reservoir **28** and an entrainment chamber **10** for use with an "entrainment jet,"

B - Independent Claim 14 and Dependent Claims 15-17 and 19-25 which pertain to a method for using the combination of a mixing tube **20** and lubrication reservoir **28** for use with an "entrainment jet,"

C - Independent Claim 27 and Dependent Claims 28-30 and 32-38 which pertain to the combination of a mixing tube **20** and a lubrication reservoir **28** for use with an "entrainment jet,"

D - Independent Claim 40 and Dependent Claims 41-43 and 45-51 which pertain to a mixing tube **20** for use with an "entrainment jet,"

E – Dependent Claims 5, 18, 31 and 44, and

F – Dependent Claims 13, 26, 39 and 52.

(8) Argument

Appellant's specification of errors and contentions with respect to Examiner's position and reasoning:

A - For Independent Claim 1 and Dependent Claims 2-4 and 6-12:

These claims were rejected as 35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 1 (reference signs added for clarity):

1. An abrasive, fluid jet cutting apparatus comprising:

a chamber **10** having an inlet **12** for receiving a pressurized fluid jet, a port **14** for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit **16** through which said fluid jet and entrained abrasives exit said chamber **10**,

a mixing tube **20** having an entry **18** port for receiving said fluid jet and entrained abrasives, an inner wall **22** for directing the flow of said fluid jet and entrained abrasives, and an outlet **24** port through which said fluid jet and entrained abrasives exit said tube **20**, wherein said tube entry **18** port is proximate said chamber exit **16**,

a lubricating fluid reservoir **28** that surrounds at least a portion of the outer wall **26** of said mixing tube **20**,

wherein at least a portion of said mixing tube wall being porous, and

wherein said lubricating fluid passes from said lubricating reservoir **28** and through said porous wall to lubricate at least a portion of the surface of said mixing tube wall so as to resist erosion of said tube wall while the fluid jet and entrained abrasives flow through said mixing tube **20**.

Appellants argue that Katz does not disclose the invention substantially as claimed for the following reasons:

(a) Appellants notes that Katz does not disclose the invention "substantially as claimed" because Claim 1 requires the following limitations that are not taught or suggested by Katz:

"a chamber having ... a port for receiving a flow of abrasive particles which are entrained into said fluid jet ... an exit through which ... entrained abrasives exit .."

" a mixing tube having an entry port for receiving ... entrained abrasives ...,"

" wherein said lubricating fluid passes ... so as to resist erosion ... while .... entrained abrasives flow through said mixing tube.

(b) As noted earlier, FIG. 1A from Katz reveals that a "slurry mixing chamber" (2 in FIG. 1A) exists in front of its mixing tube (7 in FIG. 1A), but that this "slurry mixing chamber" has no "port **14** for receiving a flow of abrasive particles" since it has only one inlet through which flows a slurry containing wet abrasive particles.

(c) The expression "entrained abrasives" is used throughout Claim 1 and the other claims of this application. However, this expression is nowhere to be found in Katz. Thus, Katz can't teach how to make a cutting jet that uses such entrained abrasives if Katz never even mentions them.

(d) Appellants legal representative offers his opinion that a contributing reason to the Examiner's unwillingness to allow the claims in question is that the Examiner does not

understand the meaning of the word "entrained" as it is commonly used to describe fluid flows. The Examiner admitted as much to the Appellants' legal representative at their August 19, 2003 interview. The Appellants hereby ask the Examiner in his Response to this Appeal Brief to admit that: (i) he still does not know what the word "entrained" means in a fluid flow context, (ii) his lack of understanding of "entrained" is a contributing reason to why he does not see the structural differences between the "entrainment chamber **10**" of the present application's FIG. 4 and the "slurry mixing chamber 7" of Katz's FIG. 1A, and (iii) his lack of understanding of "entrained" is a contributing reason to why he has not given any weighting to this word in evaluating the Applicants' claims.

(e) The Appellants further argue that the claims which depend from Claim 1 should also be allowable since they introduce further limitations that pertain to an "entrainment jet," a subject not addressed in Katz:

Claim 2: "passage … is in the range of 50-3,000 microns"

Claim 3: "abrasive particles … diameter of less than half …."

Claim 4: "lubricating fluid … viscosity .. ratio… is in the range of 100/1 – 40,000/1."

Claim 5: "lubricating fluid .. flow rate .. ratio … is in the range of 1/10,000 – 1/20."

Claim 6: "thickness of said mixing tube wall is varied along its length …"

Claim 7: "mixing tube wall has variable porosity along its length .."

Claim 8: "porous mixing tube being fabricated from a porous ceramic material."

Claim 9: from Claim 8 - "mixing tube passage .. is made by a process selected from …"

Claim 10: "porous mixing tube being fabricated from a porous metal."

Claim 11: from Claim 10 - "mixing tube passage .. is made by a process selected .."

Claim 12: from Claim 11 - "porous mixing tube being fabricated from a gravity sintered, porous material"

B - For Independent Claim 14 and Dependent Claims 15-17 and 19-25:

These claims were rejected as 35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 14 (reference signs added for clarity):

14. A method for reducing erosion on the inner wall of a cutting jet, mixing tube **20** due to a fluid jet with entrained abrasive particles flowing from said tube's inlet **18** port, along said tube's wall **22** and exiting through said tube's outlet **24** port, said method comprises the steps of:

forming said mixing tube **20** so that at least a portion of its wall **22** is porous, surrounding at least a portion of the outer wall **26** of said mixing tube wall with a lubricating fluid reservoir **28**, and

forcing lubricating fluid to pass from said lubricating reservoir **28** and through said porous wall to form a lubricating film between said mixing tube wall **22** and said flow of abrasive fluid.

Appellants argue that Katz does not disclose the invention substantially as claimed for the following reasons:

(a) Appellants notes that Katz does not disclose the invention "substantially as claimed" because Claim 14 requires the following limitation that is not taught or suggested by Katz:

"A method for reducing erosion ..... due to a fluid jet with entrained abrasive particles flowing .."

(b) As noted earlier, the expression "entrained abrasives" is used in Claim 14 and the other claims of this application. However, this expression is nowhere to be found in Katz. Thus, Katz can't teach a method for reducing erosion due to such entrained abrasives if Katz never even mentions them.

(c) In anticipation that the Examiner might alternately argue that it would have been "obvious" how to have extended Katz to develop such a method, the Applicants note that it took them over four years of research experimentation to overcome the barriers to such an extension. See Umang Anand's April 30, 2003 Rule 132 Declaration on this matter, which included portions of his 2002 Ph.D. dissertation on this topic and a copy of a research paper that he also published on this topic, "Prevention of Nozzle Wear In Abrasive Water Suspension Jets Using Porous Lubricated Nozzles" which was published in the ASME Journal of Tribology, vol. 125(1), pp. 168-180, January 2003.

(d) The Appellants further argue that the claims which depend from Claim 14 should also be allowable since they introduce further limitations that pertain to an "entrainment jet," a subject not addressed in Katz:

Claim 15: "passage ... is in the range of 50-3,000 microns"

Claim 16: "abrasive particles ... diameter of less than half ...."

Claim 17: "lubricating fluid ... viscosity .. ratio... is in the range of 100/1 – 40,000/1."

Claim 18: "lubricating fluid .. flow rate .. ratio ... is in the range of 1/10,000 – 1/20."

Claim 19: "thickness of said mixing tube wall is varied along its length ..."

Claim 20: "mixing tube wall has variable porosity along its length .."

Claim 21: "porous mixing tube being fabricated from a porous ceramic material."

Claim 22: from Claim 21 - "mixing tube passage .. is made by a process selected from ..."

Claim 23: "porous mixing tube being fabricated from a porous metal."

Claim 24: from Claim 23 - "mixing tube passage .. is made by a process selected .."

Claim 25: from Claim 24 - "porous mixing tube being fabricated from a gravity sintered, porous material"

C - For Independent Claim 27 and Dependent Claims 28-30 and 32-38:

These claims were rejected as 35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 27 (reference signs added for clarity):

27. A mixing tube apparatus for use with an abrasive, fluid jet cutting system, said system comprising a chamber **10** having an inlet **12** for receiving a pressurized fluid jet, a port **14** for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit **16** through which said fluid jet and entrained abrasives exit said chamber **10**, wherein said mixing tube apparatus comprising:

a mixing tube **20** having an entry **18** port for receiving said fluid jet and entrained abrasives, an inner wall **22** for directing the flow of said fluid jet and entrained abrasives, and an outlet **24** port through which said fluid jet and entrained abrasives exit said tube, wherein said tube entry **18** port is fixed proximate said chamber exit **16**,

a lubricating fluid reservoir **28** that surrounds at least a portion of the outer wall **26** of said mixing tube,

wherein at least a portion of said mixing tube wall being porous, and

wherein said lubricating fluid passes from said lubricating reservoir **28** and through said porous wall to lubricate at least a portion of the surface of said mixing tube

wall **22** so as to resist erosion of said tube wall while the fluid jet and entrained abrasives flow through said mixing tube **20**.

Appellants argue that Katz does not disclose the invention substantially as claimed for the following reasons:

(a) Appellants notes that Katz does not disclose the invention "substantially as claimed" because Claim 27 requires the following limitations that are not taught or suggested by Katz:

"A mixing tube apparatus for use with .... system comprising a chamber **10** having ... a port **14** for receiving a flow of abrasive particles which are entrained ..."

"a mixing tube **20** ... receiving said fluid jet and entrained abrasives"

"an inner wall **22** for directing ... entrained abrasives,"

"an outlet **24** port through which ... entrained abrasives exit ..."

"wherein ... to resist erosion ... while ... entrained abrasives flow.."

(b) As noted earlier, the expression "entrained abrasives" is used in Claim 27 and the other claims of this application. However, this expression is nowhere to be found in Katz. Thus, Katz can't teach a mixing tube apparatus for reducing erosion due to such entrained abrasives if Katz never even mentions them.

(c) In anticipation that the Examiner might alternately argue that it would have been "obvious" how to have extended Katz to develop such a mixing tube apparatus, the Applicants note that it took them over four years of research experimentation to overcome the barriers to such a development. See Umang Anand's April 30, 2003 Rule 132 Declaration on this matter, which included portions of his 2002 Ph.D. dissertation on this topic and a copy of a research paper that he also published on this topic, "Prevention of Nozzle Wear In Abrasive Water

Suspension Jets Using Porous Lubricated Nozzles" which was published in the ASME Journal of Tribology, vol. 125(1), pp. 168-180, January 2003.

(d) The Appellants further argue that the claims which depend from Claim 27 should also be allowable since they introduce further limitations that pertain to an "entrainment jet," a subject not addressed in Katz:

Claim 28: "passage ... is in the range of 50-3,000 microns"

Claim 29: "abrasive particles ... diameter of less than half ...."

Claim 30: "lubricating fluid ... viscosity .. ratio... is in the range of 100/1 – 40,000/1."

Claim 31: "lubricating fluid .. flow rate .. ratio ... is in the range of 1/10,000 – 1/20."

Claim 32: "thickness of said mixing tube wall is varied along its length ..."

Claim 33: "mixing tube wall has variable porosity along its length .."

Claim 34: "porous mixing tube being fabricated from a porous ceramic material."

Claim 35: from Claim 34 - "mixing tube passage .. is made by a process selected ..."

Claim 36: "porous mixing tube being fabricated from a porous metal."

Claim 37: from Claim 36 - "mixing tube passage .. is made by a process selected .."

Claim 38: from Claim 37 - "porous mixing tube being fabricated from a gravity sintered, porous material"

D - For Independent Claim 40 and Dependent Claims 41-43 and 45-51:

These claims were rejected as 35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 40 (reference signs added for clarity):

40. A mixing tube **20** for use with an abrasive, fluid jet cutting system, said system comprising a chamber **10** having an inlet **12** for receiving a pressurized fluid jet, a port **14**

for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit **16** through which said fluid jet and entrained abrasives exit said chamber **10**, wherein said mixing tube **20** having:

an entry **18** port for receiving said fluid jet and entrained abrasives, an inner wall **22** for directing the flow of said fluid jet and entrained abrasives, and an outlet **24** port through which said fluid jet and entrained abrasives exit said tube **20**, wherein said tube entry **18** port is fixed proximate said chamber exit **16**,

wherein at least a portion of said mixing tube wall being porous,

wherein at least a portion of said mixing tube when in use being surrounded by a lubricating fluid reservoir **28**, and

wherein said lubricating fluid passes from said lubricating reservoir **28** and through said porous wall to lubricate at least a portion of the surface of said mixing tube wall so as to resist erosion of said tube wall **22** while the fluid jet and entrained abrasives flow through said mixing tube **20**.

Appellants argue that Katz does not disclose the invention substantially as claimed for the following reasons:

(a) Appellants notes that Katz does not disclose the invention "substantially as claimed" because Claim 40 requires the following limitations that are not taught or suggested by Katz:

"A mixing tube for use with .... system comprising a chamber **10** having ... a port **14** for receiving a flow of abrasive particles which are entrained ..."

"an entry port **18** for receiving said fluid jet and entrained abrasives"

"an inner wall **22** for directing ... entrained abrasives,"

"an outlet **24** port through which ... entrained abrasives exit ..."

"wherein ... to resist erosion ... while ... entrained abrasives flow.."

(b) As noted earlier, the expression "entrained abrasives" is used in Claim 40 and the other claims of this application. However, this expression is nowhere to be found in Katz. Thus, Katz can't teach a mixing tube for reducing erosion due to such entrained abrasives if Katz never even mentions them.

(c) In anticipation that the Examiner might alternately argue that it would have been "obvious" how to have extended Katz to develop such a mixing tube, the Applicants note that it took them over four years of research experimentation to overcome the barriers to such a development. See Umang Anand's April 30, 2003 Rule 132 Declaration on this matter, which included portions of his 2002 Ph.D. dissertation on this topic and a copy of a research paper that he also published on this topic, "Prevention of Nozzle Wear In Abrasive Water Suspension Jets Using Porous Lubricated Nozzles" which was published in the ASME Journal of Tribology, vol. 125(1), pp. 168-180, January 2003.

(d) The Appellants further argue that the claims which depend from Claim 40 should also be allowable since they introduce further limitations that pertain to an "entrainment jet," a subject not addressed in Katz:

Claim 41: "passage ... is in the range of 50-3,000 microns"

Claim 42: "abrasive particles ... diameter of less than half ...."

Claim 43: "lubricating fluid ... viscosity .. ratio... is in the range of 100/1 – 40,000/1."

Claim 44: "lubricating fluid .. flow rate .. ratio ... is in the range of 1/10,000 – 1/20."

Claim 45: "thickness of said mixing tube wall is varied along its length ..."

Claim 46: "mixing tube wall has variable porosity along its length .."

Claim 47: "porous mixing tube being fabricated from a porous ceramic material."

Claim 48: from Claim 47 - "mixing tube passage .. is made by a process selected ..."

Claim 49: "porous mixing tube being fabricated from a porous metal."

Claim 50: from Claim 49 - "mixing tube passage .. is made by a process selected .."

Claim 51: from Claim 50 - "porous mixing tube being fabricated from a gravity sintered, porous material"

E - For Dependent Claims 5, 18, 31 and 44:

These claims were rejected as 35 USC § 103(a) obvious to one of ordinary skill in the art over Katz and since "discovering the optimum or workable ranges involves only routine skill in the art (*In re Aller*, 105 USPQ 233)."

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 5:

> 5. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said lubricating fluid has a flow rate whose ratio with the flow rate of the fluid jet and entrained abrasives is in the range of 1/10,000 – 1/20.

Appellants argue that the claimed invention is not obvious over Katz for the following reasons:

(a) Appellants note the following limitations are not taught or suggested by Katz:

> "flow rate of … entrained abrasives,"
>
> "ratio … is in the range of 1/10,000 – 1/20".

(b) As noted earlier, the expression "entrained abrasives" is used in Claim 5 and the other claims of this application. However, this expression is nowhere to be found in Katz. Thus, Katz can't teach or make obvious a jet cutting apparatus with reduced erosion due to such entrained abrasives if Katz never even mentions them.

(c) Appellants note that it was not obvious how to extend Katz to develop such an apparatus since it took the Appellants over four years of research experimentation to overcome the barriers to such a development. See Umang Anand's April 30, 2003 Rule 132 Declaration on this matter, which included portions of his 2002 Ph.D. dissertation on this topic and a copy of a research paper that he also published on this topic, "Prevention of Nozzle Wear In Abrasive Water Suspension Jets Using Porous Lubricated Nozzles" which was published in the ASME Journal of Tribology, vol. 125(1), pp. 168-180, January 2003.

(d) Appellants note that *In re Aller* ("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." 220 F.2d 454, 456, (CCPA 1955)) is not applicable to the claim at issue since the qualification of "the general conditions of a claim are disclosed in the prior art" is NOT true for the case at hand. The "general conditions" of the Katz cited prior art involve only experimentation with mixing tubes and lubrication reservoirs in which "premixed slurry mixtures" were used. The Appellants note that the flow conditions in an "entrainment chamber **10**" and a "slurry mixing chamber" are quite different (e.g., much higher pressures in the "entrainment chamber"); thus, the flow conditions at the entrance of their downstream mixing tubes are very different. It is these significant differences at a mixing tube's entrance that make it a nonobvious matter of how to modify the mixing tube and lubrication reservoir of Prof. Katz's earlier USPN 5,921,846 so that it can operate effectively downstream of an "entrainment chamber" **10**.

F - For Dependent, Amended Claims 13, 26, 39 and 52:

These claims were rejected as: (i) 35 USC § 103(a) obvious to one of ordinary skill in the art over Katz in view of Massa et al.'s USPN 6,425,805, and (ii) 35 USC § 112 indefinite.

35 USC § 102(b) anticipated by Prof. Katz's earlier USPN 5,921,846.

To examine the limitations of this grouping of claims, consider the appellant's following representative Claim 13 (reference signs added for clarity):

> 13. (Once Amended) An abrasive, fluid jet cutting apparatus as recited in claim 12, wherein the mixing tube passage connecting its inlet **18** and outlet **24** ports is made by using electric discharge machining to machine said porous material, and
>
> wherein the porous material for use in fabricating said mixing tube **20** and the operating parameters for said electric discharge machining of said mixing tube passage are chosen so as to yield minimum blocking of the pores on the machined surface of said mixing tube passage.

Appellants argue that the claimed invention is not obvious over Katz in view of Massa et al. for the following reasons:

(a) Appellants argue that Claims 13, 26, 39 and 52 depend from claims that are allowable and that an added limitation regarding an "electric discharge machine" cannot make the claims "obvious" in the manner described above.

(b) As noted earlier, the expression "entrained abrasives" is used in Claim 1 from which Claim 13 depends. However, this expression is nowhere to be found in Katz or Massa et al. Thus, Katz and Massa et al. can't teach or make obvious a jet cutting apparatus with reduced erosion due to such entrained abrasives if Katz and Massa et al. never even mention them.

Appellants admit that Claims 13, 26, 39 and 52, as currently written, are 35 USC § 112 indefinite. If these claims cannot be adequately amended, they will be cancelled from the application.

Conclusion:

In view of the foregoing arguments, Appellants respectfully request that the USPTO Board of Patent Appeals and Interferences reverse the Examiner's rejection of Claims 1-12, 14-25, 27-38 and 40-51 and allow the Appellants to further amend Claims 13, 26, 39 and 52 so as to place them in a condition for allowance.

Respectfully submitted,

1/23/04
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CERTIFICATE OF MAILING

I hereby certify that this correspondence, and attachments, if any, will be deposited with United States Postal Service, First Class Mail, postage prepaid, on the date indicated below and will be addressed to the Commissioner for Patents, U.S. Patent & Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450, ATTN: Dung V. Nguyen, Group 3723.

Signature: _____ DATE OF DEPOSIT: 1/23/04

APPENDIX

A copy, with markings to show changes made, of rejected claims 1-52 follows:

1. An abrasive, fluid jet cutting apparatus comprising:

a chamber having an inlet for receiving a pressurized fluid jet, a port for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit through which said fluid jet and entrained abrasives exit said chamber,

a mixing tube having an entry port for receiving said fluid jet and entrained abrasives, an inner wall for directing the flow of said fluid jet and entrained abrasives, and an outlet port through which said fluid jet and entrained abrasives exit said tube, wherein said tube entry port is proximate said chamber exit,

a lubricating fluid reservoir that surrounds at least a portion of the outer wall of said mixing tube,

wherein at least a portion of said mixing tube wall being porous, and

wherein said lubricating fluid passes from said lubricating reservoir and through said porous wall to lubricate at least a portion of the surface of said mixing tube wall so as to resist erosion of said tube wall while the fluid jet and entrained abrasives flow through said mixing tube.

2. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports is in the range of 50-3,000 microns.

3. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said abrasive particles have an average diameter of less than half of the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports.

4. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said lubricating fluid having a kinematic viscosity whose ratio with the kinematic viscosity of said jet's carrier fluid is in the range of 100/1 – 40,000/1.

5. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said lubricating fluid has a flow rate whose ratio with the flow rate of the fluid jet and entrained abrasives is in the range of 1/10,000 – 1/20.

6. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein the thickness of said mixing tube wall is varied along its length to control the flow rate of the lubricating fluid.

7. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said mixing tube wall has variable porosity along its length to control the flow rate of the lubricating fluid.

8. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said porous mixing tube being fabricated from a porous ceramic material.

9. An abrasive, fluid jet cutting apparatus as recited in claim 8, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous ceramic material.

10. An abrasive, fluid jet cutting apparatus as recited in claim 1, wherein said porous mixing tube being fabricated from a porous metal.

11. An abrasive, fluid jet cutting apparatus as recited in claim 10, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous metal.

12. An abrasive, fluid jet cutting apparatus as recited in claim 11, wherein said porous mixing tube being fabricated from a gravity sintered, porous material.

13. (Once Amended) An abrasive, fluid jet cutting apparatus as recited in claim 12, wherein the mixing tube passage connecting its inlet and outlet ports is made by using electric discharge machining to machine said porous material, and

wherein the porous material for use in fabricating said mixing tube and the operating parameters for said electric discharge machining of said mixing tube passage are chosen so as to yield minimum blocking of the pores on the machined surface of said mixing tube passage.

14. A method for reducing erosion on the inner wall of a cutting jet, mixing tube due to a fluid jet with entrained abrasive particles flowing from said tube's inlet port, along said tube's wall and exiting through said tube's outlet port, said method comprises the steps of:

forming said mixing tube so that at least a portion of its wall is porous,

surrounding at least a portion of the outer wall of said mixing tube wall with a lubricating fluid reservoir, and

forcing lubricating fluid to pass from said lubricating reservoir and through said porous wall to form a lubricating film between said mixing tube wall and said flow of abrasive fluid.

15. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports is in the range of 50-3,000 microns.

16. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said abrasive particles have an average diameter of less than half of the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports.

17. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said lubricating fluid having a kinematic viscosity whose ratio with the kinematic viscosity of said jet's carrier fluid is in the range of 100/1 – 40,000/1.

18. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said lubricating fluid has a flow rate whose ratio with the flow rate of the fluid jet and entrained abrasives is in the range of 1/10,000 – 1/20.

19. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein the thickness of said mixing tube wall is varied along its length to control the flow rate of the lubricating fluid.

20. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said mixing tube wall has variable porosity along its length to control the flow rate of said lubricating fluid.

21. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said porous mixing tube being fabricated from a porous ceramic material.

22. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 21, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous ceramic material.

23. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 14, wherein said porous mixing tube being fabricated from a porous metal.

24. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 23, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous metal.

25. A method for reducing erosion on the inner wall of said mixing tube as recited in claim 24, wherein said porous mixing tube being fabricated from a gravity sintered, porous material.

26. (Once Amended) A method for reducing erosion on the inner wall of said mixing tube as recited in claim 25, wherein the mixing tube passage connecting its inlet and outlet ports is made by using electric discharge machining to machine said porous material, and

wherein the porous material for use in fabricating said mixing tube and the operating parameters for said electric discharge machining of said mixing tube passage are chosen so as to yield minimum blocking of the pores on the machined surface of said mixing tube passage.

27. A mixing tube apparatus for use with an abrasive, fluid jet cutting system, said system comprising a chamber having an inlet for receiving a pressurized fluid jet, a port for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit through which said fluid jet and entrained abrasives exit said chamber, wherein said mixing tube apparatus comprising:

a mixing tube having an entry port for receiving said fluid jet and entrained abrasives, an inner wall for directing the flow of said fluid jet and entrained abrasives, and an outlet port through which said fluid jet and entrained abrasives exit said tube, wherein said tube entry port is fixed proximate said chamber exit,

a lubricating fluid reservoir that surrounds at least a portion of the outer wall of said mixing tube,

wherein at least a portion of said mixing tube wall being porous, and

wherein said lubricating fluid passes from said lubricating reservoir and through said porous wall to lubricate at least a portion of the surface of said mixing tube wall so as to resist erosion of said tube wall while the fluid jet and entrained abrasives flow through said mixing tube.

28. A mixing tube apparatus as recited in claim 27, wherein the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports is in the range of 50-3,000 microns.

29. A mixing tube apparatus as recited in claim 27, wherein said abrasive particles have an average diameter of less than half of the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports.

30. A mixing tube apparatus as recited in claim 27, wherein said lubricating fluid having a kinematic viscosity whose ratio with the kinematic viscosity of said jet's carrier fluid is in the range of 100/1 – 40,000/1.

31. A mixing tube apparatus as recited in claim 27, wherein said lubricating fluid has a flow rate whose ratio with the flow rate of the fluid jet and entrained abrasives is in the range of 1/10,000 – 1/20.

32. A mixing tube apparatus as recited in claim 27, wherein the thickness of said mixing tube wall is varied along its length to control the flow rate of the lubricating fluid.

33. A mixing tube apparatus as recited in claim 27, wherein said mixing tube wall has variable porosity along its length to control the flow rate of the lubricating fluid.

34. A mixing tube apparatus as recited in claim 27, wherein said porous mixing tube being fabricated from a porous ceramic material.

35. A mixing tube apparatus as recited in claim 34, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous ceramic material.

36. A mixing tube apparatus as recited in claim 27, wherein said porous mixing tube being fabricated from a porous metal.

37. A mixing tube apparatus as recited in claim 36, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous metal.

38. A mixing tube apparatus as recited in claim 37, wherein said porous mixing tube being fabricated from a gravity sintered, porous material.

39. (Once Amended) A mixing tube apparatus as recited in claim 38, wherein the mixing tube passage connecting its inlet and outlet ports is made by using electric discharge machining to machine said porous material, and

wherein the porous material for use in fabricating said mixing tube and the operating parameters for said electric discharge machining of said mixing tube passage are chosen so as to yield minimum blocking of the pores on the machined surface of said mixing tube passage.

40. A mixing tube for use with an abrasive, fluid jet cutting system, said system comprising a chamber having an inlet for receiving a pressurized fluid jet, a port for receiving a flow of abrasive particles which are entrained into said fluid jet, and an exit through which said fluid jet and entrained abrasives exit said chamber, wherein said mixing tube having:

an entry port for receiving said fluid jet and entrained abrasives, an inner wall for directing the flow of said fluid jet and entrained abrasives, and an outlet port through which said fluid jet and entrained abrasives exit said tube, wherein said tube entry port is fixed proximate said chamber exit,

wherein at least a portion of said mixing tube wall being porous,

wherein at least a portion of said mixing tube when in use being surrounded by a lubricating fluid reservoir, and

wherein said lubricating fluid passes from said lubricating reservoir and through said porous wall to lubricate at least a portion of the surface of said mixing tube wall so as to resist erosion of said tube wall while the fluid jet and entrained abrasives flow through said mixing tube.

41. A mixing tube as recited in claim 40, wherein the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports is in the range of 50-3,000 microns.

42. A mixing tube as recited in claim 40, wherein said abrasive particles have an average diameter of less than half of the smallest cross sectional dimension of the passage connecting said mixing tube inlet and outlet ports.

43. A mixing tube as recited in claim 40, wherein said lubricating fluid having a kinematic viscosity whose ratio with the kinematic viscosity of said jet's carrier fluid is in the range of 100/1 – 40,000/1.

44. A mixing tube as recited in claim 40, wherein said lubricating fluid has a flow rate whose ratio with the flow rate of the fluid jet and entrained abrasives is in the range of 1/10,000 – 1/20.

45. A mixing tube as recited in claim 40, wherein the thickness of said mixing tube wall is varied along its length to control the flow rate of the lubricating fluid.

46. A mixing tube as recited in claim 40, wherein said mixing tube wall has variable porosity along its length to control the flow rate of the lubricating fluid.

47. A mixing tube as recited in claim 40, wherein said porous mixing tube being fabricated from a porous ceramic material.

48. A mixing tube as recited in claim 47, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous ceramic material.

49. A mixing tube as recited in claim 40, wherein said porous mixing tube being fabricated from a porous metal.

50. A mixing tube as recited in claim 49, wherein the mixing tube passage connecting its inlet and outlet ports is made by a process selected from the group consisting of casting, molding and machining processes for said porous metal.

51. A mixing tube as recited in claim 50, wherein said porous mixing tube being fabricated from a gravity sintered, porous material.

52. (Once Amended) A mixing tube as recited in claim 51, wherein the mixing tube passage connecting its inlet and outlet ports is made by using electric discharge machining to machine said porous material, and

wherein the porous material for use in fabricating said mixing tube and the operating parameters for said electric discharge machining of said mixing tube passage are chosen so as to yield minimum blocking of the pores on the machined surface of said mixing tube passage.